

European form.

cone. Colour, first green, then brown. Sometimes stalked.

Dense squamæ, representing converted cupule; generally concealing the acorn.

Squamæ closely appressed in the earlier stage of growth, less so when mature.

Acorn stunted, standing upright on a central axis. Acorn converted into a capacious larval cell, dropping to the ground in autumn.

Insect. *Aphilotrix gemmæ*, Linn. (*Cynips fecundatrix*, Hartig).

Chinese form.

"One distinctly stalked."

"Dense" squamæ ("of the cupule"?) entirely concealing the acorn. (No cupule is visible in the figure.)

Squamæ looking like those of *Q. dentata*, Thunb., though closely appressed, instead of being more or less reflexed. (The figure does not show them closely appressed.)

No evidence. (No acorn visible in the figure.)

Insect not known. *A Cynips?*

I have not taken any notice of the different Chinese localities whence the above facts were procured. The European *Cynips* has an extensive range; and its Chinese ally is not likely to be worse off in this respect.

It now behoves the residents on the spot to prosecute this inquiry; the naturalist at home has done his share by calling attention to the matter.

On the Geographical Distribution of the Diurnal Lepidoptera as compared with that of the Birds. By W. F. KIRBY, Assistant in the Museum of the Royal Dublin Society, author of 'A Catalogue of Diurnal Lepidoptera,' &c.

[Read February 15, 1872.]

THE preparation of my 'Catalogue of Diurnal Lepidoptera' has furnished me with materials for a paper on the general distribution of the group, which I have hitherto always shrunk from attempting. It happens that the number of species recorded slightly exceeds that of the number of birds as estimated by Dr. Selater* in his paper "On the general Geographical Distribution of the Members of the Class Aves" (Journ. Linn. Soc. Zool. vol.

* Gray now enumerates upwards of 11,000 species; but it is more convenient to take Selater's estimate in the present paper.

ii. pp. 130–145), but approaches it so nearly as to render a comparison between the Rhopalocera and the Aves extremely easy as well as interesting (birds, Selater, 7500; butterflies, Kirby, 7700).

Had I been dealing with Lepidoptera only, I would certainly have united Dr. Selater's "Palæarctic Region" and "Nearctic Region;" for although the species of North-American Rhopalocera are seldom identical with those of northern Asia and Europe, still the genera are the same with scarcely an exception, except a few representatives of South-American genera, which have no more right to be considered Nearctic species than the similar chance representatives of African forms in North Africa or South-west Europe, or of Indian forms in South-east Europe, have to be considered Palæarctic species. But for purposes of comparison it will be better to adhere to the geographical provinces mapped out by Dr. Selater, commencing with:—

I. *Palæarctic Region.*

"*Extent.*—Africa north of the Atlas, Europe, Asia-Minor, Persia and Asia generally north of the Himalaya range, upper part of Himalaya range? [certainly the north-west Himalayas], Northern China, Japan, and the Aleutian Islands. Approximate area of 14,000,000 square miles."

Characteristic forms.—*Erebia*, *Æneis* (circumpolar), **Melanargia*, *Satyrus*, *Epinephile*, *Hipparchia*, *Cænonympha*, **Triphysa*, *Argynnis*, *Melitæa*, **Araschnia*, *Vanessa*, **Nemeobius*, *Lycena*, **Thestor*, *Plebeius*, **Læosopis*, **Zephyrus*, **Leucophasia*, **Gonepteryx* (sect. typ.), *Colias*, **Zegris*, **Euchloë*, **Mesapia*, **Hypermnestra*, **Doritis*, *Parnassius*, **Sericinus*, **Thais*, *Thymelicus*, **Erynnis*, *Hesperia*, *Carterocephalus*.

The above are all genera which may without any doubt be considered highly characteristic of the Palæarctic region, many being entirely confined to it, and others, though widely distributed, reaching their maximum of size and colour within its boundaries. The genera marked with an asterisk do not, with the doubtful exceptions of *Gonepteryx* and *Erynnis*, extend to the Nearctic region; nor, except *Gonepteryx* and *Zephyrus*, which extend to the Himalayas, do they so much as touch the Indian region. Although the genus *Plebeius* is widely distributed, yet it seems rather to belong to the Palæarctic fauna than to any other.

As is the case with the birds, the genera of *Rhopalocera*, characteristic of this district, are far from equalling many of the

splendid tropical forms in size and brilliancy: but, on the other hand, the number of peculiar forms is considerable; and the tropical representatives of boreal genera by no means surpass those of temperate regions; and I have myself observed that on comparing Indian and European representatives of the same species the Indian specimens are generally smaller, owing probably to the more rapid development of the larvæ in a warmer climate.

With regard to the peculiarities of distribution within the limits of the Palæarctic region, we have, first, the Arctic fauna, which is practically circumpolar; next the central fauna, stretching through the vast plains of Central Asia-Europe, and in which we may also include the Alpine fauna. The bulk of the central species are bounded to the south by the Alps and Pyrenees; and hence the fauna of Spain is much poorer than that of France, and that of Italy than that of Austria. South of the Alps, in Europe, we find the Mediterranean fauna, which has several little groups peculiar to itself. There is probably a south-central steppe fauna in Central Asia; but too little is known of that region to enable us to say more than that it produces several peculiar forms of high interest, *e. g.* *Hypermnestra*. The south-east of Europe is much richer in species than the south-west; for there are fewer obstacles to the southern spread of the central fauna in that direction.

Still it is difficult to account for the much greater number of species in East-central than in West-central Europe.

The Alpine species are scarcely represented at all in the mountains of the extreme south of Europe; and not a single truly Alpine species is yet known to occur in the mountains of North Africa. The extrinsic elements of the Palæarctic fauna consist, first, of isolated Nearctic and Indian forms in Japan and Manchuria (*Midea*, *Papilio*, &c.); second, of a few Indian forms in Eastern Europe (*Neptis*, *Danaus*, &c.); and, third, in a few African forms in South Europe and North Africa (*Charaxes*, *Callosune*).

It is very difficult to estimate the real number of known species occurring in the Palæarctic region, on account of the division between this and the Indian region intersecting China and the Himalayas; but they may be set down as about 630* at a very moderate computation. Dr. Sclater gives the area of the Palæarctic region as 14,000,000 square miles, and the number of spe-

* Species occurring in more than one region are enumerated under both in this paper.

cies of birds as about 650, or one species for each 21,000 square miles. The proportion of butterflies is apparently somewhat less, being one species for each 22,222 miles. This is no doubt partly owing to incomplete observations, and partly to butterflies being, for various reasons, more local than birds. It appears, however, that butterflies are really less abundant in the Palæartic region than birds; for Dr. Staudinger's last Catalogue, which takes in the whole district except Japan, Thibet, and North China, enumerates only 456 species, whereas Dr. Sclater enumerates 581 birds as inhabitants of Europe alone.

II. *Æthiopian or Western Palæotropical Region.*

“*Extent.*—Africa south of the Atlas range, Madagascar, Bourbon, Mauritius, Socotra, and probably Arabia up to the Persian Gulf, south of 33° north latitude; an approximate area of 12,000,000 square miles.”

Characteristic forms.—*Amauris*, *Gnophodes*, *Leptoneura*, *Bicyclus*, *Heteropsis* (Madagascar), *Cænys*, *Acræa*, *Lachnoptera*, *Precis*, *Salamis*, *Orenis*, *Euxanthe*, *Amphidema*, *Pseudacræa*, *Catuna*, *Euryphene*, *Euphædra*, *Hamanumida*, *Aterica*, *Cymothoë*, *Meneris*, *Charaxes*, *Palla*, *Pentila*, *Liptena*, *D'Urbania*, *Axiocerses*, *Aphnæus?* *Capys*, *Phytala*, *Epitola*, *Hewitsonia*, *Deloneura*, *Pseudopontia*, *Belenois*, *Idmais*, *Teracolus*, *Callosune*, *Abantis*, *Ceratrichia*, *Leucochitonea*, *Caprona*, *Cyclopides*.

Africa possesses a great number of peculiar forms, which compensate in some measure for the absence of most of the characteristic Palæartic or Indian genera, and for the very sparing manner in which most of the remainder are represented (by one or two species only): especially remarkable is the small number of *Satyrinæ* (barely fifty species) known to inhabit the Ethiopian region. Strange to say, Madagascar and the adjacent islands possess very few characteristic groups among the *Rhopalocera*. Nearly all the species belong to well-known African genera, and are in many cases identical with those of the mainland. The fauna of Africa and Madagascar has more affinity with that of India than with that of Europe, but is far more removed from either than they are from each other. I must not forget to allude here to the moth *Chrysidia rhipheus*, which, though a Mascarene insect, has no very close affinity to any Old-World species, but is nearest allied to the Tropical-American genus *Urania**. Similarly

* Since the above was written, a second species of *Chrysidia* has been described from Zanzibar (*C. Cræsus*, Gerst.).

two species of *Hypanartia*, a Tropical-American genus, occur in Africa and Madagascar. South Africa is remarkably poor in species, and can hardly number more than 250. Most of the characteristic genera of Tropical Africa are entirely absent, or very poorly represented, though the number of species peculiar to Southern Africa is very considerable in proportion to the total. A summary of their geographical distribution is given by Mr. Trimen at the end of his 'Rhopalocera Africae Australis.'

Dr. Sclater estimates the birds of the Æthiopian region at 1250 species, or one species to 9600 square miles: but here the deficiency of known butterflies is still more remarkable than in the Palæartic region; for they do not number more than 733, or one species to 16,400 miles nearly. It must be remembered, however, that a very small proportion of Africa has yet been explored entomologically; but the small number of species known from the best-explored portion (South Africa) proves beyond a doubt that its Lepidopterous fauna is extremely poor, although the greater portion of the species belong to genera almost peculiar to Africa. The insects of Africa are also extremely uniform in character, the same genera and often the same species occurring in localities so widely removed as Sierra Leone, Mozambique, and Natal.

III. Indian or Middle Palæotropical Region.

"*Extent*.—India and Asia generally, south of Himalayas; Ceylon; Burmah; Malacca and Southern China; Philippines; Borneo; Java; Sumatra and adjacent islands: an area of perhaps 4,000,000 square miles."

Characteristic forms.—*Zophoessa*, *Lethe*, *Neope*, *Cœlites*, *Zethera*, *Ragadia*, *Yphthima*, *Melanitis*, *Amathusia*, *Zeuzidia*, *Discophora*, *Enispe*, *Clerome*, *Æmona*, *Thaumantis*, *Cethosia*, *Cirrochroa*, *Cynthia*, *Junonia*, *Rhinopalpa*, *Kallima*, *Amnosia*, *Hestina*, *Euripus*, *Penthema*, *Lebadea*, *Limenitis*, *Neptis*, *Athyma*, *Euthalia*, *Tanaëcia*, *Symphædra*, *Apatura*, *Charaxes*, *Dodona*, *Taxila*, *Miletus*, *Allostinus*, *Ilerda*, *Sithon*, *Deudorix*, *Liphyra*, *Amblypodia*, *Tachyris*, *Prioneris*, *Dercas*, *Calinaga*, *Teinopalpus*, *Leptocircus*, *Taractrocera*, *Tagiades*.

By far the richest district in the world, except South America. The principal characteristic forms are enumerated above; and these are almost, if not entirely, confined to the Indian region, though several have outlying representatives in Celebes alone—

an island whose relations are somewhat doubtful and peculiar, but which perhaps belongs rather to the Australian region than to the Indian (but compare Mr. Wallace's paper "On the Zoological Geography of the Malay Archipelago," Journ. Linn. Soc. Zool. iv. p. 172). On the other hand, India possesses numerous representatives of many Palæartic and African genera; and many other genera are about equally divided between the Indian and African, or Australian, regions. A great similarity exists between the insects of North India and those of Singapore; the species peculiar to South India and Ceylon are imperfectly known at present, and a study of their affinities would no doubt be highly interesting and instructive. It may be expected, however, that the south of India is much poorer in species than the north, and would display African or Australian affinities rather than Palæartic.

Although this fauna is very rich in comparison with any that have preceded it, still only 1250 butterflies are known from the Indian region, against 1500 birds; so that here also the birds are much more richly represented. Thus while in the birds we have one species to each 2600 square miles nearly, in the butterflies we have but one to 3200. Yet the zoology of the Indian region is far better known than that of any other, except the Palæartic and perhaps the Nearctic.

IV. *Australian or Western Palæotropical Region.*

"*Extent.*—Papua and adjacent islands, Australia, Tasmania, and Pacific Islands; an area of perhaps 3,000,000 square miles."

Characteristic forms.—*Hestia*, *Ideopsis*, *Danaus*, *Euplœa*, *Hamadryas*, *Bletogona* (Celebes), *Argyrophenga* (New Zealand), *Xenica* (Australia), *Heteronympha* (Aust.), *Xois* (Fiji), *Acrophthalmia*, *Hypocysta*, *Tenaris*, *Hyantis* (Waigiou), *Messaras*, *Atella*, *Hypolimnas*, *Apaturina* (Amboyna), *Parthenos*, *Mynes*, *Prothoe*, *Dicallaneura*, *Lucia*, *Hypochrypsops*, *Utica*, *Ialmenus*, *Ogyris*, *Elodina*, *Delias*, *Eurycus* (Aust.), *Ornithoptera*, *Netrocoryne* (Aust.), *Trapezites* (Aust.), *Hesperilla* (Aust.), *Euschemon* (Aust.).

The Australian region, although very rich in peculiar forms of Lepidoptera Heterocera, is poor in butterflies. It has much affinity to the Indian region, many genera, as *Euplœa*, *Danaus*, and *Papilio*, being pretty evenly divided between the two. On the other hand, the marked absence of most of the characteristic Indian genera, and the almost total absence of all forms characteristic of any other region, point out the Australian region as sufficiently distinct from any other.

Dr. Sc Slater estimates the birds of the Australian region at 1000, or one species to every 3000 square miles; the number of butterflies is 725, or one to every 4138 miles.

V. *Nearctic or North-American Region.*

"*Extent.*—Greenland and North America down to centre of Mexico; area of perhaps 6,500,000 square miles."

Characteristic forms.—*Æneis* (circumpolar), *Grapta*, *Midea*.

The poverty of this region, as compared with every other, is most remarkable. Many of the characteristic forms of the Palæarctic fauna are absent in North America, although the Palæarctic region has representatives of every North-American genus except a few representatives of the characteristic forms of Southern America. The few genera mentioned above are the only ones in which the number of species is slightly greater than in the Palæarctic region.

While the number of birds in the Nearctic region is estimated at 660, or one in 9000 square miles, that of the butterflies is only 480, or not more than one in about 13,800 miles. It thus appears that though North America has so few characteristic forms, yet it is richer than the Palæarctic region in the number of its species as compared with its extent. It must be remembered, however, that this is owing partly to the sameness of the Palæarctic region, and partly to the European fauna being better known than the American, and to the slighter characters on which species are established by American Lepidopterists: 300 good species occur in Europe alone; and it may well be doubted whether America, east of the Rocky Mountains, produces more. California and Chili, though the former is necessarily included in the Nearctic and the latter in the Neotropical region, do not really belong to them, but are rather to be regarded as outlying portions of the Palæarctic region, many Palæarctic forms being represented in the New World in these districts only.

VI. *Neotropical or South-American Region.*

"*Extent.*—West-India islands, Southern Mexico, Central America and whole of South America, Galapagos Islands, Falkland Islands; estimated area of about 5,500,000 square miles."

I have found it expedient to credit the Neotropical region with the whole of the Mexican *Rhopalocera*; for all the described species, with very few exceptions, if we omit the species common to

Mexico and the United States, belong to purely tropical genera. On the other hand, Cuba and perhaps some of the other West-Indian islands have so strong an affinity in their productions to the Southern States of America, that the line should probably be drawn between two of them in the same way that Mr. Wallace draws the line between the Indo- and Austro-Malayan regions. Jamaica and Trinidad produce chiefly tropical forms; but in Haiti, and still more in Cuba, the northern and southern faunæ mix, with a preponderance of northern forms. The Nearctic region will probably prove to be somewhat richer than has been previously shown when the intermediate faunæ are better known, and the lines can be drawn with more accuracy. Little or nothing has been done in the West Indies, except in the four islands previously mentioned. The only butterfly known to me to inhabit the Galapagos Islands is a single species of the cosmopolitan genus *Plebeius* (*P. parrhasioides*, Wgr.), which genus, however, is badly represented in all the tropical and southern faunæ.

Characteristic forms.—*Ithomia*, *Mechanitis*, *Melinæa*, *Hætera*, *Cærois*, *Euptychia*, *Tisiphone*, *Oressinoma*, *Elina* (Chili), *Etæona*, *Lymanopoda*, *Calisto* (Antilles), *Pronophila*, *Corades*, *Bia*, *Morpho*, *Brassolis*, *Opsiphanes*, *Dynastor*, *Penetes*, *Caligo*, *Narope*, *Dasyophthalma*, *Colænis*, *Dione*, *Clothilda*, *Phyciodes*, *Chlosyne*, *Hypanartia*, *Napæocles*, *Anartia*, *Cybdelis*, *Eunica*, *Epiphile*, *Myscelia*, *Catonephele*, *Temenis*, *Dynamine*, *Catagramma*, *Callithea*, *Batesia*, *Ageronia*, *Didonis*, *Cystineura*, *Lucinia* (Ant.), *Pyrrhogyra*, *Megalura*, *Victorina*, *Adelpha*, *Aganisthos*, *Prepona*, *Agrias*, *Smyrna*, *Megistanis*, *Anæa*, *Hypna*, *Siderone*, *Protozonius*, *Lemoniida* (all except the genera *Nemeobius*, *Dodona*, *Zemeros*, *Abisara*, *Taxila*, and *Dicalaneura*), *Thestor*, *Lamprospilus*, *Theorema*, *Eumæus*, *Trichonis*, *Peeute*, *Archonias*, *Hesperocharis*, *Dismorphia*, *Perrhybris*, *Leucidia*, *Daptonoura*, *Nathalis*, *Euryades*, *Thymele*, *Telegonus*, *Entheus*, *Pyrrhopyge*, *Erycides*, *Butleria*, *Pythonides*, *Achlyodes*, *Helias*.

Long as this list is, it is a mere selection of the overflowing riches of this district, which produces more than half of all the described species of Rhopalocera. Not only is every genus enumerated above (except *Thecla*, which is represented by a very few obscure species in Europe and North Asia), as well as all its allies, entirely confined to the New World, but the *Lycænidæ* and *Pierinæ* are less richly represented than the other groups.

The great majority are wholly unrepresented north of Mexico.

All the great cosmopolitan genera, such as *Papilio*, *Pieris*, *Eurema*, &c., are represented in South America by whole groups often of so much importance that they ought rather to be reckoned as genera than groups. Again, many genera, like *Apatura* and *Thecla*, which do not extend to Africa, are abundantly represented; while, on the other hand, *Catopsilia* and *Danaus*, almost purely tropical genera in the Old World, send out offshoots far into the United States. This, however, is a parallel case to the occurrence of Indian forms in Mantchuria, which in the west and centre of Asia-Europe are purely tropical.

The Neotropical region is far richer in Rhopalocera than in birds. Dr. Sclater estimates the birds at 2250 species, or one to each 2400 square miles; but the number of Rhopalocera already known is not less than 4200, which is about equivalent to a species to each 1310 miles. Nor is it likely that this enormous number would be materially affected by the uncertainty as to how much of Mexico should be included in the Neotropical region, as the greater part of the Mexican species are found in South America also.

I have not added a comparative Table of the number of birds and butterflies in each region, as there are a considerable number of species of the latter of doubtful locality not included in my summary, and this can be better done when future discoveries have enabled us to check the rough results already arrived at in a more perfect manner than is possible at present with our existing materials.

[The following Table was prepared to illustrate the reading of Mr. Kirby's paper, and is therefore added here.—H.T.S.]

	Birds.	Butterflies.
Total number of species	7500	7700
Europe, North Asia, Persia, Asia } Minor and North Africa	650	630
Africa, Central and Southern, Madagascar, &c. } India and Indian archipelago	1250	733
Australia	1500	1250
North America	1000	725
South America	660	480
	2250	4200
